AMENDMENT TO THE SPECIFICATION

Please amend the specification paragraphs set forth below to read as follows:

Two paragraphs at page 7, lines 10-25:

FIGURE 1 is a cross-section schematic diagram of a two-layer carrier structure comprising a carrier liner 10 and a cross-linkable adhesive layer 20. Carrier structures of the present invention may also include cross-linkable adhesive layers 20 comprising a combination of permanent tacky controlled peel strength adhesive and thermal-UV releasing adhesive within a single layer 20. Thus, differential peel strength is produced after thermal-UV exposure. The adhesive layer 20 first releases the chips or other objects carried and then releases the carrier base 10, enabling the replacement of adhesive layer 20 for reuse of typical carrier base 10. Such a combination adhesive preferably releases both chips <u>60</u> and liner 10 without leaving a residue, and also preferably has greater adhesion to liner 10 than to the chip or other object <u>60</u> carried so that the chip is released more easily than is the liner 10.

With the use of thermal-UV releasing tacky layer 20, the adhesion is very strong during the transporting and handling, as long as the cross-linkable layer 20 is protected from exposure to thermal-UV energy. The release of the chips <u>60</u> is made dramatically easier by exposure of the tacky layer 20 to thermal-UV, generally right before the pick-and-place operation or other use or process.

Paragraph at page 9, lines 21-26:

It is noted that the tackiness adjustment desirably is made with the size, weight, and nature of the object <u>60</u> to be carried in mind. Where the object <u>60</u> has a relatively large smooth area that contacts the tacky adhesive, as is the case for a large area semiconductor chip, a lesser tackiness is sufficient. For an object <u>60</u> that has a contact area that is only a relatively small portion of its size, as is the case for a finned surface of a heat sink device, somewhat greater adhesion may be desired.

Two paragraphs at page 12, lines 6-22:

FIGURE 2 is a cross-section schematic diagram of a three-layer carrier structure comprising a carrier liner or base 10, a cross linkable adhesive layer 20, and a non-cross linkable adhesive layer 30. In order to extend the concept of the use of "release-on-command" structure, i.e. by application of suitable EMR, a laminate of adhesive films may be used. This laminate film may have two layers, each with different adhesive characteristics. The layer 20 that contacts objects 60 to be carried such as dice or chip parts 60 may be pressure sensitive with substantial bonding strength of about 100-5000 gm/inch peel strength that will be reduced to less than about 50 gm/inch after cross-linking upon exposure to UV light, heat or other suitable electromagnetic energy, such as microwaves. The electromagnetic energy should be sufficient to overcome the activation energy barrier of the molecular reaction or reactions, e.g., cross linking that will reduce the adhesion characteristics.

The second layer 30 of the adhesive laminate should be coated with a strong adhesive, e.g. about 100-5000 gm/inch, that will not be dramatically affected by thermal-UV or other radiation exposure. This second, non-curable adhesive layer 30 should be easily removable from the carrier base 10, so that the carrier base 10 can be reused after application of a new adhesive laminate.

Seven paragraphs beginning at page 14, line 9, through page 16, line 4:

The above embodiments provide for electromagnetic radiation to penetrate through the carrier structure in order to cross-link the tacky layer 20, as dice and components 60 are typically not transparent to cross-linking radiation. To the extent that the tacky layer 20 is cross-linked by thermal energy, transparency to EMR is less of a concern, although increasing the thermal conductivity of the carrier structure increases the efficiency of the cross-linking. Thus materials such as transparent polystyrene, acrylics, polycarbonate or other EMR-transparent materials are preferably used for molding the carrier structure base 10. Alternatively, the carrier liner 10 may be physically modified, as by the provision of a suitable portion or cavity or window formed

in the liner to transmit the EMR. Preferably, the transmission properties of the portion and/or physical modifications are sufficient to allow the tack strength to be reduced to less than about 30% of the original (pre-EMR exposure) value so that the carried devices are readily released during pick-and-place operations.

FIGURE 4 is a cross-section schematic diagram of an embodiment of the invention wherein the carrier is in the form of a tape, and the carrier tape liner [[10]] 10a forms a trough. To maximize opportunities for re-use, it is desirable that the carrier structure be compatible with components or other items 60 to be carried of varying sizes, and not be specifically sized for a particular object. The specific sizes of the carrier structures may or may not follow industrial standards such as those established by JEDEC (Joint Electronics Device Engineering Council) or others.

To this end, the use of a trough configuration tape [[10]] 10a rather than formation of multiple specific size pockets or pouches facilitates flexibility. In embodiments which the carrier structure is a tape, for example, the width of the carrier tape determines the only restriction on the size of the component 60, and tapes of the same width with different pocket lengths need not be manufactured. Thus fewer versions of these tapes, and the reels on which they are would in tape-and-reel packaging are required. The economics of scale thus obtained further reduce the manufacturing cost and therefore the cost of using such tapes. In addition, the application of the adhesive layer 20 to a long trough-type carrier tape liner [[10]] 10a is simpler and more economical than the application of an adhesive layer only in the many pockets of a pocket-type liner.

The carrier base or substrate [[10]] 10a is preferably of suitable rigidity and thickness to control or conform to the flatness of the parts carried. Typically, the cavity or trough of the carrier base [[10]] 10a is at least as deep as the height of the component or device that it is intended to hold. The carrier base [[10]] 10a may also be provided advantageously with such other features as are well known in the art, for example, sprocket holes or other means of guiding and/or feeding a carrier structure in the form of a tape. Some of these advantageous optional features are shown in the embodiment

depicted in Figures 4 and 5 described herein.

In the present invention, high temperature polymers are used as the cross-linkable adhesive of tacky layer 20 and also as the liner [[10]] <u>10, 10a</u> for the adhesive 20. These polymer and adhesive layers may be engineered so that the onset of significant degradation occurs at temperatures above about 300°C, and preferably above about 350°C, as measured by standard thermogravimetric analysis (e.g., measurement of weight loss at temperature increase rate of 10°C per minute under standard atmospheric conditions).

In addition to the thermal stability of the polymer molecular structure under an air atmosphere, this carrier base [[10]] <u>10, 10a</u> is preferably a polymer with sufficient cross-linked density such that the tacky adhesive film 20 will not easily or permanently deform under the mechanical forces to which it will be subjected under typical manufacturing conditions. On balance, however, the carrier base [[10]] <u>10, 10a</u> should be slightly flexible, for example, to permit realistic or even generous tolerances in alignment with manufacturing equipment. Accordingly, it is preferred that a sufficient portion of the polymer structure have a glass transition temperature (Tg) substantially below ambient temperature and preferably below about 20°C.

Carrier structures of the present invention are laminate films with a mechanical support liner [[10]] <u>10, 10a</u> that is typically about 1-10 mils or about 25-250 microns in thickness. Thicker liners <u>10, 10a</u> can be used for special cases, but for economic reasons, thicknesses of about 3-6 mils are preferred.

Paragraph beginning at page 16, line 5 through line 13:

Most of the conventional liners currently used are plasticized PVC film that is both inexpensive and has reasonable bonding characteristics, with higher surface energy (over about 40 dyne/cm) to facilitate adhesion to the acrylic pressure sensitive adhesives that commonly constitute the cross-linkable tacky layer being used. While PVC liners are low in cost, they are deformed easily at temperatures above 65-70°C and thus cannot be used for high-temperature or heat-generating operations, such as lapping or

machining. For example, lapping operations to reduce the thickness of a ~~silicone~~ silicon wafer from 20 mils to 1-2 mils generate a substantial amount of frictional heat, with *in situ* temperatures easily exceeding 70°C.

Two paragraphs beginning at page 16, line 27, through page 17, line 10:

A polymer with low enough surface energy to form good bond to the silicone layer must be used. There are very few such pressure sensitive media that can bond to silicone liner 10, 10a, which tends to have the lowest surface energy surface among all polymer structures. In any case, silicone pressure sensitive layers share the common problem of free silicone monomer residue transfer which is to be avoided

Examples of suitable substrates or liners [[10]] 10, 10a for such non-silicone gel cross-linkable adhesives are conventional ABS, PET, polycarbonate, polyester, high impact polystyrene, or polysulfone, polyethersulfone, or other engineering plastics or liquid crystal polymers. This substrate [[10]] 10, 10a can be metal or ceramic if suitable plastics cannot provide specific desirable properties, with at least portions being of a suitable EMR transparent material. In most high volume applications, polymers that can be molded offer much lower cost and great versatility in terms of shape and format. Carrier liner [[10]] 10, 10a preferably comprises a non-silicone dielectric such as AI Technology type ESP7450 flexible adhesive which includes cross-linked epoxy with high flexibility, or a combination thereof with a silicone material.

Seven paragraphs beginning at page 17, line 18, through page 19, line 17:

FIGURES 5A and 5B are a cross-section schematic diagram and a plan view schematic diagram, respectively, of an embodiment of a carrier structure wherein the carrier is in the form of a tape [[10]] 10b having a cover 50. The carrier structures of the present invention may optionally be provided with an anti-static cover 50 with either a flat tape as illustrated or with a trough tape structure [[10.]] 10b. Such a cover structure 50 may have thermal-UV blocking properties and is typically about 5-15 mils thick and may be comprised of PET or another relatively rigid film to provide mechanical

protection.

Cover 50 may be secured to tape [[10]] 10b by tacky adhesive layer 20, as illustrated, and so is conveniently released by the same exposure to EMR that is utilized for releasing the chips or other objects carried thereon.

Tape [[10]] 10b is a long strip of carrier base [[10]] 10b material that is slightly wider than is the strip of tacky thermal-UV adhesive 20 disposed thereon. Carrier tape [[10]] 10b may have drive sprockets illustrated by the circular holes along either one or both edges thereof, which holes serve as a means to impart motion (drive) the tape and/or for aligning the tape with respect to apparatus such as pick-and-place equipment.

Alternatively and optionally, a cavity or window may be formed in a carrier structure [[10]] 70 to allow energy (EMR) to pass through carrier base [[15]] 10 to expose and cure the tacky layer 20 to achieve similar reduction of tackiness of the areas exposed. FIGURE 6 is an isometric schematic diagram of an exemplary embodiment of a carrier wherein a ledge 11 in the carrier structure [[10]] 70 serves as a support for a radiation-transparent carrier base insert [[15]] 10, upon which the adhesive layer 20 is disposed. Adhesive layer 20 may be any one of the two-layer, three-layer and four-layer embodiments described above. An object [[50,]] 60, such as a semiconductor chip or other electronic component is also shown in place on adhesive layer 20. Alternatively, a transparent rigid backing substrate [[15]] 10 may be used. The desirable characteristics of such a backing substrate [[15]] 10 include transparency to the EMR that is used to cure the tacky layer, preferably transparency to UV, microwave or e-beam radiation. Suitable rigid backing substrates [[15]] 10 include, for example, inorganic glasses such as quartz, silicate glasses or organic glasses such as polycarbonate, polystyrene, and acrylic. Desirably the rigid backing substrate [[15]] 10 is low enough in cost so that it is economically feasible to discard it after each use.

Also alternatively, and/or optionally, the laminate of adhesive layer 20 is protected from cross linking by UV light before the carrier structure is used by means of a UV barrier release liner 50. Typically, such release liner/cover 50 is placed over tacky layer 20 and over carrier base [[15]] 10 to block EMR that would crosslink adhesive

layer(s) 20 and will be removed from the UV curable tacky layer 20 prior to use. Such block may be restored or applied after the object 60 is placed on tacky layer 20 to block cross-linking EMR until such time as it is desired to release object [[50.]] <u>60.</u> The carrier base platform [[15]] <u>10</u> may be removable or non-removable from the waffle pack, tape-and-reel, and JEDEC tray configuration, as is desired.

Where carrier structure [[10]] <u>70</u> is a JEDEC carrier, the useful and UV active areas of base [[15]] <u>10</u> have dimensions typically about 5" by about 12". The tray has a ledge 11 for releasably supporting carrier base [[15]] <u>10</u> and retaining lips 12 at least on two long side of the tray so that the platform and the tray can be slightly bent to allow insertion of the removable platform [[15]] <u>10</u>. The platform [[15]] <u>10</u> is typically about 1/16" thick. It is apparent that platforms [[15]] <u>10</u> of different thickness or shape or size can be used to create non-standard carriers. The removable platform [[15]] <u>10</u> is preferably constructed with a UV transparent substrate such as glass, acrylic, polycarbonate, and the like. If high temperature exposure is required, for example, baking at 150°C for an extended period of time to remove moisture from the components, non-shattering glass or cross-linked plastics are often preferred.

In some embodiments, a single layer 20 of thermal-UV curable liquidous mixture with a high temperature stable polymer is made with a typical ratio of liquidous portion in the range of about 30-80% and preferably in the range of about 40-60%. This ratio will assure the adhesive layer 20 has adequate film forming characteristics without an adhesive base or liner 40. Typically a thicker adhesive film 20 in the range of about 2-10 mils thickness will be used if the liner is omitted. The adhesive film 20 will be sandwiched between two UV-opaque release liners to prevent UV cross-linking when not desired. The adhesive-liner assembly [[15]] <u>10, 20</u> can be die-cut to specific preform dimensions to fit the active and useful areas of the platform [[15]] <u>10</u> and carrier [[10.]] <u>structure 70.</u>

Two paragraphs at page 20, lines 1-17:

All of these high-surface-energy polymers may be used for baking out moisture,

e.g., at about 150°C. If extended exposure to higher temperature of about 200-350°C for a few minutes must be used, the more useful polymers will be those of polyvinylidene fluoride or its copolymer. Some of block co-polymers such as Kraton G series made by Shell Chemical Company or similar thermoplastic elastomer resin with high temperature stable backbone may be used. Preferably the adhesive has a higher and more permanent adhesion to the carrier base film or liner [[10]] <u>10, 10a, 10b</u> than to the items to be carried and that the adhesive layer 20 be of sufficient thickness (typically about 1-5 mil) to hold parts with slightly different flatness tolerances.

In some embodiments, the release of the parts is aided by an ejector pin assembly as is conventional. The pins are projected towards the parts through a flexible layer [[10,]] <u>10, 10a, 10b,</u> thus raising the parts for easier grasping. In addition, the flexible layer [[10]] <u>10, 10a, 10b</u> is preferably deformed by the ejector pins so that it detaches partially from each part. In this way, the force necessary to remove the parts from the adhesive layer 20 is decreased because of the loss of adhesion caused by thermal-UV curing of adhesive layer 20 as well as by the reduced contact area between the adhesive and the part.

Two paragraphs at page 21, lines 4-17:

In a waffle pack, for example, a repeat pattern of holes in the base [[10]] <u>10, 10a, 10b</u> are spaced about 1/16" to 1/8" apart and spread evenly over the area of the base of the tray, and the ejector pin-set has a reciprocal matching arrangement similar to a male-female arrangement, such that the pins will ~~bass~~ <u>pass</u> through the holes to provide an ejection mechanism. In these embodiments, the flexible layer [[10]] <u>10, 10a, 10b</u> is preferably a firm, non-silicone elastomer with structural integrity, such as AI Technology types CC7450 or ESP7450. The flexible layer [[10]] <u>10, 10a, 10b</u> may optionally support a tacky layer 20 in contact with the parts, and is attached to the carrier, preferably at least at its edges.

In embodiments comprising a removable platform [[15]] <u>10</u> and a replaceable thermal-UV-releasing layer 20, it is estimated that each carrier structure of the present

invention can be used at least ten times or more. This re-use provides significant savings in manufacturing costs. For example, if a typical JEDEC tray of $3.00 to $5.00 value is used ten times or more, the cost is less than $0.30-$0.50 per use. It follows that the cost of each tray usage per chip is also reduced by a similar factor.